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COLLATERAL AND RISK SHARING IN GROUP LENDING: EVIDENCE FROM AN URBAN MICROCREDIT PROGRAM

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COLLATERAL AND RISK SHARING IN GROUP LENDING: EVIDENCE FROM AN URBAN MICROCREDIT PROGRAM*

Abstract
Empirical research on the impact and determinants of group lending is by now substantial. However, very little is known about the possible role of collateral to mitigate incentive problems in group lending. This is because microcredit programs have normally been implemented in rural areas of developing countries. Indeed, the reason for this choice is lack of credit access since agents with collateral are very rare. Also, to the extent that rural communities have tight-knit hierarchical structures information about borrowers is accessible and the enforcement of sanctions via social networks makes collateral superfluous for default mitigation. Yet, in an urban setting in which information is more atomized and social sanctions are not as powerful, collateral may have an important role in group lending. First, we illustrate in a model the role of collateral to mitigate group default. Second, we use data from a group lending program implemented in 2001 in Cotonou, the largest city in Benin with more than one million inhabitants. We empirically explore the risk profile of individual borrowers and resulting group heterogeneity to identify the role of personal contributions to investment projects. Our evidence suggests that while diversification within groups facilitates risk pooling, it also increases expected bailout or group default costs for low risk borrowers. Collateral helps offset and alleviate potential negative spillovers from group default induced by membership of borrowers with risky projects. The presence of borrowers with collateral facilitates access to credit for group members without collateral, who in turn provide insurance against group default. We find joint liability to be a mechanism for risk sharing in a setting where poor households lack resources for collateral and insurance markets are missing.

Keywords: Group lending, mutual cosigners, collateral, risk sharing, strategic default, bailout costs.
JEL Codes: O12, O17, G20, D82

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Introduction

In recent years microfinance has transformed from being an experimental alternative to formal and informal sources of credit to being a model for lending programs to the poor and a development tool for poverty alleviation. Microfinance has allowed credit to the poor beyond the traditional financial frontiers insofar as lack of collateralizable assets has been overcome by group lending in tight-knit communities. Social cohesion giving rise to norms and sanctions to deter default has provided a form of social collateral in group lending situations. Also, knowledge transmission via social networks reduces information asymmetry within communities. Hence, in small villages with high poverty rates and limited availability of resources for collateral, social capital has become a catalyst for the successful implementation of joint liability credit programs. In order to expand the traditional financial frontiers, microfinance has developed tailored financial services based on a set of incentives for borrowers to repay their loans and for lenders to provide innovative financial products. The result has been high repayment rates that guarantee the long-term sustainability of financial organizations.

The successful performance of microfinance institutions has been extensively debated, especially in terms of the methods of credit delivery. In particular, group lending receives most of the interest in research and in practice. The key feature of this contractual method is shared liability making the entire group responsible for the loans given to individual borrowers. First, group lending mitigates information asymmetry. Joint liability, inducing borrowers to carefully self-select choose their groups, can provide a solution to adverse selection faced by lending institutions (Ghatak, 1999; van Tassel, 1999; Armendariz and Gollier, 2000) At the same time peer monitoring mitigates moral hazard (Stiglitz, 1990; Banerjee, Besley and Guinnane, 1994; Armendariz, 1999; Wydick, 1999 and 2001). Second, group lending facilitates enforcement of penalties on defaulters when borrowers have close ties (Besley and Coate, 1995; Wydick, 1996). The potential role of collateral has been absent from the discussion in the group lending literature by an large. A notable exception is Prescott and Townsend (2002) who model coalitions pooling resources of agents with perfect information about each other, allowing for individual resource heterogeneity. Part of the reason is that joint liability schemes have been designed precisely to overcome credit inaccessibility when agents lack collateral resources. In particular, group

lending has been most intensively deployed in rural areas in developing countries where lack of assets is generalized. By delegating borrower selection and monitoring to other group members, financial intermediaries can attain profitable repayment rates even without collateral. Group members belonging to the same social networks have at their disposal a larger set of punishment instruments for default than remote financial intermediaries.

Most of the theoretical models are based on the paradigm that credit groups will form among members of equal risk leading to the hypothesis of homogeneous matching. The first argument is due to partner selection inducing borrowers in joint liability agreements to select peers to minimize the expected costs of either bailing out other group members or costly group default. This implies that the safest borrowers will only accept other group members with similar risk profiles. At the same time, the riskiest borrowers can only group with partners of similar levels of risk. Therefore, there will be homogeneous matching in equilibrium, or at least assortative matching, where any risk heterogeneity is due to the unavailability of partners of the same type or matching frictions in the group formation process affecting borrowers' ability to find their preferred partner (Armendariz, 1999). The second line of argument focuses on adjustments in project selection as borrowers in a group will encourage their partners into investments no riskier than their own, or will leave risky groups, resulting in an equilibrium with group members of the same risk (Stiglitz, 1990).

These models generally imply that group homogeneity is optimal. This is partly due to the assumption of uncorrelated investment returns ruling out benefits from risk pooling. Loic Sadoulet (2000) has pointed out that while the tolerable degree group heterogeneity depends on the borrowers' outside option, in the absence of insurance markets heterogeneity may be a risk diversification vehicle. It is conjectured that transfers between group members can make coalitions between low and high risk investors stable. Intra-group insurance is modelled by Wydick (2001) in a dynamic context as sustainable given that loss of future credit to defaulters is sufficiently costly. In the present paper, we consider joint liability agreements as vehicles for risk sharing, with collateral as the mechanism that makes heterogenous groups sustainable. When some but not all agents have collateral, we argue that group lending may be relevant not only to provide credit to agents without collateral but also to provide insurance to agents with collateral. This can be especially relevant to borrowers in urban of developing countries,

where social sanctions are limited but interaction between households with and without collateral resources is feasible.

Empirical research on microcredit has mainly concentrated on group formation and peer monitoring. The role of collateral in joint liability agreements has not empirically explored yet. In the past, it has been suggested that transfers or side payments could sustain heterogenous groups in what effectively amounts to high risk members purchasing insurance from low risk ones. However, there no evidence provided that such transfers take place. In this paper, we test whether the presence of collateral facilitates mutual insurance in group formation. Our empirical results show that heterogenous groups emerge in which members with high risk investment projects mitigate default prospects through collateral. This shows that joint liability is conducive to insurance provision as long as there is a mechanism for high risk investors in the group to commit agains strategic default and compensate low risk investor members.

Attanasio and Davis (1996) have shown that even in the US, where contingent security markets are far more advanced than in any developing country, the joint cross-sectional distribution of household earnings and consumption is inconsistent with insurance against earnings risk implied by the Arrow-Debreu paradigm. Storesletten, Telmer and Yaron (2004) show that idiosyncratic earnings shocks realized during the working life of household members are sufficiently large and persistent to account for more than half of the cross sectional variation in earnings in the US. Indeed household earnings shocks have the same degree of persistence as business cycles shocks, but their volatility dwarfs that of cyclical fluctuations. Income risk is especially important in developing countries as a large share of households live close to the subsistence income threshold. It is essential to enhance the scope for consumption smoothing and to understand ways in which risk can be shared across households. The analysis in this paper suggests that the use of group lending in urban areas of developing countries may be one such way.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 presents a benchmark model to illustrate the role of collateral fro risk sharing in group lending. Section 4 provides a description of the data. Section 5 discusses the empirical strategy and implications of our results. Finally, section 6 offers concluding remarks.

2 Related Literature

In developing countries, lending institutions possess limited information on the type and behavior of their clients. However, group lending can enhance the financial intermediaries' ability to screen and monitor their borrowers. Microfinance institutions are designed to overcome asymmetric information in the relationship between bank and borrower, by transferring the screening and monitoring functions at the community level to jointly liable borrowers. Reporting the advantages of collective actions in screening and monitoring with respect to distant bank agents, Stiglitz (1990) and Varian (1990) emphasize that group members have easy access to information on the reputation, creditworthiness and efforts of their peer borrowers thus facilitating enforcement of loan repayment . However, the repayment performance of group lending under joint liability may be undermined because of the risk sharing in case of default. In fact, a member may, intentionally, choose an excessively risky project counting on the other members to repay. Therefore, if borrowers have perfect information about each other type, will self-select homogeneously with respect to investment risk (Stiglitz 1990; Devereux and Fisher 1993; Ghatak, 1999). Given this selection mechanism, Ghatak (2000) shows how lenders can exploit the degree of joint liability to screen between borrowers of different type. Safe borrowers prefer a higher degree of joint liability and a lower interest rate, risky borrowers a lower degree of joint liability and a higher interest rate. However, since the lender does not know borrower type and collateral are not available, it has to offer the same interest rate to all borrowers. As a consequence, safe borrowers are driven out of the credit market (Stiglitz and Weiss, 1981). On the other hand, risky borrowers with unproductive projects may be cross-subsidized by safe borrowers with productive project (De Meza and Webb, 1987). Starting from the last consideration, safe borrowers, trough joint liability, are attracted back in the credit market and risky borrowers are pushed away. Therefore, joint liability is seen as an instrument to exploit local information to alleviate credit market failures and to improve the economic efficiency. The notion that joint liability induces borrowers to group with partners with the same risk profile is challenged by Sadoulet (2000) who suggests that, in a context of missing insurance markets, homogeneity is not necessarily optimal. If the group fails, it will lose access to future credit. Insurance arrangements could compensate the safe borrowers for covering for the risky ones in cases of need, such as risk-

premia transfers from the riskier to the safer member. Heterogeneity, defined by the literature as a second-best outcome, can become the first-best. Wydick (2001) develops a framework with dynamic incentives to derive the possibility of intra-group insurance. In contrast to the independence of project returns assumed by the authors mentioned until now, Laffont (2003) considers exogenously fixed potential pairs of ex ante identical entrepreneurs who carry projects with correlated returns and have limited liability. The model incorporates the problem of collusion leading to strategic group default. He describes optimal lending contracts in the class of individually incentive compatible, when the bank deals with adverse selection problems. Group lending contracts are guided by the revelation mechanism which do not rely on the ex post observability of investment project returns but on private information only. When collusion occurs and information is complete, group lending contracts are shown to be optimal.

Another argument for homogeneity focuses on the benefits of group lending ex post to group formation: the costs of monitoring a peer decrease if she undertakes the same trade (Devereux and Fisher, 1993) and when there are social ties group lending can improve repayment rates and relax credit rationing (Floro and Yotopolous, 1991). Group lending may also reduce the incentive for moral hazard relative to individual lending if the threat of social penalties is sufficiently high in the case of borrower default (Besley and Coate, 1995). Other models emphasize the potential benefits of peer monitoring and intra-group credit insurance. Stiglitz (1990), Conning (1999) and Armendariz (1999) show how peer monitoring among borrowing groups members reduce the incentive for risk-taking. Moreover, Varian (1990) and Rashid and Townsend (1992) explain the role of insurance among group members when negative stochastic shocks occur, if borrowers project returns are not highly correlated. In contrast to the bulk of the literature, Prescott and Townsend (2002) allow for collateral when groups of agents informed about each other pool resources. Such arrangements are shown to be optimal in the presence of sufficient heterogeneity among agents, including inequality. In contrast to the bulk of the literature, Prescott and Townsend (2002) allow for collateral when groups of agents informed about each other pool resources. Such arrangements are shown to be optimal in the presence of sufficient heterogeneity among agents, including inequality.

Empirical studies explore either the issue of group formation or the occurrence of peer monitoring. Wydick (1999, 2001) analyzes data from a microcredit program in Guatemala, comprising 139 groups in 1994, finding

evidence of risk sharing with group expulsions as the discipline device against defaults. Sadoulet and Carpenter (2001), analyzing a 1995 microcredit program with 450 groups in Guatemala, provide empirical evidence of the existence of both homogeneous and heterogeneous groups with respect to risk at the same time. To explain this simultaneity, they argue that group formation is endogenous and the risk taken by each borrower is jointly determined by her choice of partner. Heterogeneity is the result of the welfare-maximizing actions of the members of the group. Group lending leads to heterogeneous groups to the extent that riskier members pay a premium in good states of nature to safer borrowers. By allowing transfers between members, heterogeneous formation of the group is a Pareto improvement over homogeneous formation. Only individuals who are too risky will not find safe borrowers willing to match with them and, therefore highly risky borrowers will form separate homogeneous groups. Lensik and Mehrteab (2003) conduct a survey in 2001 among group members and group leaders of borrowers who accessed to loans from two microcredit programs in Eritrea. Their main results strongly indicate that groups are formed heterogeneously. Most importantly, they do not find support for the matching frictions hypothesis, in the sense that even if they control for matching frictions, credit groups in Eritrea do not seem to consist of borrowers of the similar risk type. De Weeerdt (2001) on the basis of household and network data collected in a Haya village in Tanzania, finds that kinship, geographical proximity, the number of common friends, clan membership, religious affiliation and wealth strongly determine network formation. Insights in endogenous network formation are used to assess vulnerability of households, distinguishing between those likely to experience network shocks and those who are not. The results reveal that there are weak networks that collapse under shocks and strong networks that can cope with these shocks. The latter is likely if households tend to link up with others of similar wealth, occupation and place of residence.

As far as monitoring is concerned, Hermes, Lensik and Teki (2001), dealing with data coming from participants of 102 groups in Eritrea, provide an empirical analysis of the impact of monitoring and social ties on moral hazard behaviors. Regular contacts and short distance between the group leader and group member reduce moral hazard behavior of group members and minimize misuse of loans. Also, Karlan (2003), analyzing FINCA Peru data, argues that monitoring costs are reduced when individuals live closer to each other. Cultural heterogeneity and geographic dispersion matter greatly

to the effectiveness of peer monitoring and enforcement of lending contracts. Peer lending is more effective if individuals who live closer and are more alike culturally are grouped together. This notion that social capital is a catalyst to financial intermediation is explored by Guiso et al. (2002) where regional variation in trust across regions in Italy is found to impinge on the management of personal finances. Finally, Ahlin and Townsend (2003) use heterogeneity in repayment rates among groups to find determinants of the success of joint liability arrangements. They find that in the poorest region of Thailand the role of social sanctions emphasized by Besley and Coate (1995) and Wydick (1996) seems crucial. None of these empirical papers contemplate any form of collateral substitute, apart for joint liability.

3 Risk Sharing and Group Default with Collateral: A Theoretical Framework

The model presented below to illustrate how the presence of collateral affects incentives under joint liability is based on Besley and Coate (1995). We adapt their model of the role of group sanctions facilitating the build up of social collateral to enhance group lending to a situation in which sanctions among group members are limited to the repossession of assets. First, we discuss the case of individual borrowing as a benchmark. Then, we analyze the case of joint liability. After that we compare the performance of individual and group lending. Finally, we characterize the role of collateral in mitigating strategic default and facilitation mutual insurance in the context of joint liability.

3.1 Individual Lending

A risk neutral borrower has a project, requiring one unit of capital, that lasts for one period and yields θ units of income. The project return is known when the project has been realized. Ex ante it is common knowledge that θ is distributed on $[\underline{\theta}, \overline{\theta}]$ according to the distribution function $F(\theta)$ that has the properties of being continuous on $[\underline{\theta}, \overline{\theta}]$ and satisfying $F(\underline{\theta}) = 0$.

At the end of the period, the borrower decides whether to reimburse the loan by paying $r > 1$, including both principal and interest, or to default. In the latter case, the bank inflicts sanctions on the defaulting borrower, represented by the continuous and increasing penalty function $p(\theta)$. The penalty function represents the loss to the borrower due to seizure of profits from the project by the lender, and it increases with the project return.[2]

Evaluating the cost of repayment, r, and the penalty in case of default, $p(\theta)$, the borrower chooses to repay if and only if $r \leq p(\theta)$. We let the critical project return at which the borrower is indifferent between repayment and default by $\theta = \phi(r)$, where $\phi(\cdot) \equiv p^{-1}(\cdot)$ is defined as the inverse of the penalty function $p(\cdot)$. Since $p(\cdot)$ is increasing in the project return, the loan will be repaid if and only if the project return is greater than the critical project return. This implies the probability of repayment is be given by $\Pi_I(r) = 1 - F(\phi(r))$, with $F(\underline{\theta}) = 0$. The probability of repayment is decreasing in r, insofar $\phi(r)$ is increasing.

We assume $\phi(1) > \underline{\theta}$, so that from the bank's perspective, it not possible to obtain repayment for every project return. Therefore, there are possible profit realizations such that the borrower may decide not to pay the loan even if it were interest free (i.e. $r = 1$). The default rate is, in fact, positive for all positive interest rates, i.e. for all $r > 1$.

3.2 Group Lending

We assume the group to be composed of two ex ante identical borrowers, borrower 1 and borrower 2 running two independent projects whose

[2]The loss could also have nonmonetary elements such as pestering by debt collectors or loss of face due to public announcements. Also, another way to specify the penalty function would be to consider a repeated game in which the lender implements a trigger strategy of shutting down future access to credit. This would be a less costly way for the lender to penalize defaulters. However, it would require the introduction of incremental credit needs by borrowers, for the loss of credit access to be sufficiently costly.

returns, θ_1 and θ_2, are common knowledge once realized. They get a loan of two units of capital at the beginning of the period and are jointly liable to repay $2r$, the loan principal plus interest rate, at the end of the period. The repayment decision is an all or nothing decision, hence the group either repays $2r$ or does not repay. To contrast deliquent borrowers the lender applies the penalties $p(\theta_1)$ and $p(\theta_2)$.

The repayment game is articulated in two stages. Both the borrowers simultaneously take the decision of contributing their share, r, or not at the first stage of the game. If they contribute, the loan is repaid and their payoffs are $(\theta_1 - r, \theta_2 - r)$. Whereas, if they do not contribute, then the loan is not repaid and the lender imposes penalties: $(\theta_1 - p(\theta_1), \theta_2 - p(\theta_2))$. However, if one of the borrowers has decided not to contribute, at the second stage of the game the other borrower has to decide whether or not to repay the whole loan herself. In this case, if the loan is repaid by borrower 1, the payoff is $(\theta_1 - 2r, \theta_2)$. If borrower 1, like borrower 2, instead decides to take default alternative, the payoffs are

$$(\theta_1 - p(\theta_1), \theta_2 - p(\theta_2))$$

From borrower 2's point of view, the former option has the advantage that she does not face the lender sanctions. We now characterize the project return vectors (θ_1, θ_2) for which there is group loan repayment.

Proposition 1: *If* $\theta_i > \phi(2r)$ *for either* $i = 1$ *or 2, there is repayment. If* $\phi(r) < \theta_i \leq \phi(2r)$ *for both* $i = 1$ *and 2, the loan may be repaid. Otherwise, i.e.* $\phi(r) > \theta_i$ *for either* $i = 1$ *or 2, there will be group default. The repayment rate under group lending is:* $\Pi_G(r) = \left[1 - \{F(\phi(2r)\}^2\right] + \left[F(\phi(2r) - F(\phi(r)\right]^2$

Proof: See appendix.

Now, we want to compare repayment rate under group lending with that obtained under individual lending:

$$\begin{aligned}\Pi_G(r) - \Pi_I(r) &= \left[1 - \{F(\phi(2r)\}^2\right] + \left[F(\phi(2r)) - F(\phi(r))\right]^2 - \left[1 - F(\phi(r))\right] \\ &= F(\phi(r))\left[1 - F(\phi(2r))\right] - \left[F(\phi(2r)) - F(\phi(r))\right] F(\phi(r))\end{aligned}$$

This expression captures the trade-off faced by lenders who are considering

the adoption of group lending to improve repayment rates. The first term represents the mutual insurance effect. It is the probability that one borrower will have a return above $\phi(2r)$, when the other has a return below $\phi(r)$. A return below $\phi(r)$, when the individual lending scheme is adopted, would lead to insolvency and default. In contrast, in group lending, trough the joint liability instrument, the much more fortunate borrower, i.e. with a return above $\phi(2r)$, will also repay the share of the less fortunate borrower, effectively providing insurance against the lender penalty.

The second term represents the negative spillover from individual default under joint liability. It is the probability that one borrower has a return between $\phi(r)$ and $\phi(2r)$ while the other has a return below $\phi(r)$. In the individual lending scheme the borrower with a return between $\phi(r)$ and $\phi(2r)$ would repay. However, under joint liability, this otherwise solvent borrower would default because the burden of repaying the whole group loan by herself exceeds the default penalty. In this case, there is a negative drag down effect from the group member with the unprofitable project as her default imposes a burden on the other member, as well as on the lender as the whole group loan is defaulted. There is group default, even though one group member would have repaid if she had not been faced with liability for her partner's share. When one of the partner's project fails, there is negative spillover on the other group member who although is capable to cover her individual liability may opt to default rather than paying the loan of the other group member.

3.3 Collateral

The above framework assumed no costs to a borrower from not contributing her share of the group loan, except for the penalties to individual members imposed by the bank in the event of group default. Here, we consider what happens in the case of group lending when we allow for the possibility of asset repossession, where an individual's assets can be expropriated by a group lending partner. We demonstrate how the existence of collateral can improve the performance of group lending.

In village economies, with tight knit communities, the imposition of sanctions through hierarchical social networks can provide a mechanism to

enforce joint liability agreements and in many developing countries, this is the most appropriate context in which to analyze group lending. The role of social norms to induce repayment under joint liability is incorporated in the literature (e.g. Besley and Coate, 1995; and Wydick, 1996) and, in particular, it has been shown how the lack of collateral induced by widespread poverty, which makes credit inaccessible, can be overcome if social cohesion can be harnessed to mitigate strategic default in group lending.

We consider group lending performance in a different environment in which (i) social sanctions have limited impact and (ii) some borrowers possess resources for collateral. These conditions can prevail in urban contexts in developing countries where communities are atomized relative to rural communities. Also, in cities it is possible for poor individuals to interact with better off individuals and potentially form a group under a joint liability agreement. In general, the role of collateral in the analysis of group lending has been ignored because microcredit arrangements were precisely a response to grant credit to those without access to formal credit. Hence, the benchmark has been a situation in which resources for collateral are lacking. We complement existing analyses by allowing for collateral in order to motivate our empirical analysis of group lending in an urban environment, as described in the next section. While it might seem superfluous to grant microcredit to individuals who have resources for collateral, we show that they can draw in group members who would otherwise have no access to credit. Hence, the provision of microfinance to individuals who also have access to formal credit does not necessarily lower welfare as has been argued before (e.g. Mosley and Hulme, 1996). The gain in terms of making possible access to credit for borrowers without collateral, in contexts where social sanctions are insufficient, could exceed the potential loss due to crowding out of other poor potential borrowers.

We motivate repossession among group members in joint liability agreements from the observation that, unlike individual lending contracts, group members can affect each others' payoffs. For example, if an individual chooses not to contribute her share of a group loan, then she may adversely affect her partner's payoff. The loss faced by an individual who contributes when her partner does not is r if she chooses to repay the group loan herself, and $p(\theta) - r$ if she decides to default.

In either case, assuming that $p(\theta) \geq r$, she is worse off than she would have been if her partner had contributed her share. It is the fact that she

suffers this loss that may lead a borrower to expropriate her partner if the latter does not pay her share. In terms of the repossession of assets, we only allow for the expropriation of those investments in the project associated for the group loan. In particular, the share of investment financed with personal contributions can potentially be seized by other members of the group.

The repossession penalty function, denoted by $R(\bullet)$ depends on the loss inflicted by the noncontributing member on her partner, and also upon the profitability of the project associated with the defaulting loan. The latter says that if a noncontributor has a relatively unprofitable project, then the expropriation penalty is smaller. Define the loss for a member with project return θ of the group when the other has decided not to contribute as $L(\theta, r) = \min[p(\theta) - r, r]$.

Let the repossession function be given by $R\left(L(\theta, r), \theta'\right) = \mu\lambda[L, \theta']$, with $\frac{\partial\lambda}{\partial L} > 0$ and $\frac{\partial\lambda}{\partial\theta'} > 0$, where μ is the personal contribution of the group member to her individual investment project financed with the group loan and $\lambda[L, \theta']$ is the fraction of that contribution that would be repossessed by the other group member in the event of default by that group member. We now characterize the project return vectors (θ_1, θ_2) for which there is group loan repayment, when there is collateral and repossession is possible.

Proposition 2: As before if $\theta_i > \phi(2r)$ *for either* $i = 1$ *or 2, there is repayment. If* $\phi(r) < \theta_i \leq \phi(2r)$ *for both* $i = 1$ *and 2, the loan may be repaid. If* $\phi(r) < \theta_i \leq \phi(2r)$ *for one group member* i *but* $\theta_j \leq \phi(r)$ *for the other member* j*, then there is repayment if* $p(\theta_j) + R(p(\theta_i) - r, \theta_J) > r$ *Otherwise, there will be group default.*

Proof: See appendix.

The repayment rate may be higher as individuals with unprofitable projects but with collateral will not default in order to avoid loss of investment. In particular, without collateral a situation in which borrower 1 is individually solvent but not enough to cover the whole group loan, $\phi(r) < \theta_1 \leq \phi(2r),$ while the other group member has a lower project return $\theta_2 \leq \phi(r)$, would lead to group default. But, in the case in which borrower 2 has collateral, there may be repayment as long as the

repossession costs exceed the gain from default $R(p(\theta_1) - r, \theta_2) > r - p(\theta_2)$. Hence, the negative spillovers from unprofitable projects are mitigated as group members with profitable projects and lenders can avoid the losses due to group default. At the same time, collateral can enhance the prospects of group members with collateral to obtain insurance under joint liability (i.e. whole group loan repayment by borrower 1, if $\theta_2 \leq \phi(r)$ but $\theta_1 > \phi(2r))$ as the willingness of other borrowers to form a group with them as members rises.

Now we establish that given enough collateral availability, the possibility of asset repossession among group members can guarantee higher repayment under joint than individual liability. This would mean that the mutual insurance effect of group lending would dominate the negative spillover effect.

Proposition 3: If mutual insurance is possible in group lending (i.e., $\phi(2r) < \overline{\theta})$, *the repayment under group lending exceeds that under individual lending given sufficiently high group member personal contribution* μ .

Proof: See appendix.

Collateral is thus a mechanism for avoiding default under joint liability. To the extent that group default is not only harmful to the lender but also to group members losing access to future credit, personal investment contributions can enhance group formation under joint liability. In the present context, without social sanctions, unless collateral is sufficiently high, we cannot be certain that group lending will deliver higher repayment rates than individual lending.

There is a financial institution related to group lending under collateral, which also involves joint liability, namely the use of cosigners. This refers to persons other than the main borrower who assume equal liability for repayment of the loan. Cosigners are effectively guarantors of the debt and to be acceptable to the lender need either enough collateral or reputation. In the same vein, when a low risk borrower forms a group with a high risk borrower, without recourse to social sanctions, it requires collateral to be provided. Also, when an borrower with collateral forms a group with a borrower without collateral, it requires that agent to invest in a low risk project. In group lending, borrowers are effectively each others cosigners. Normally for someone to agree to be somebody else's cosigner they tend to be very closely related, usually next of kin, presumably as in those circumstances the cosigner has private information about the borrower and

also can more easily enforce nonpecuniary penalties for default. However, in joint liability schemes, group formation among relatives is ruled out by design and in urban environments social sanctions are limited. Therefore group members are willing to be each other's cosigners if they perceive default sufficiently unlikely due to either sufficient partner's collateral or investment project safety. Hence, in developing country cities, group lending can enhance the risk sharing among households achieved with standard cosigner agreements by expanding this type of arrangement to be applied between households belonging to different communal organizations or kinship networks.

4 Data and Survey Description

We analyze the group lending program which was launched in Benin's largest city in October 2001 by GNO'NU and IFOLD (Istituto Formazione Lavoro Donne), both NGOs with seat in Cagliari in collaboration with Benin Interaction, a local NGO. Region Sardinia contributed 70% of the resources for the scheme and the remaining 30% was contributed by the above named organizations. The aim of the program was to provide financial services to poor women. While, the long term objectives were the reinforcement of women's participation in economic activity, and more generally, in society, as well as the improvement of health and educational conditions for them and their families. First, we provide an account of the program. Then, we describe the data.

4.1 Group Lending in Cotonou

The program was set up in the periphery of Cotonou, which is the largest city in Benin with 1.1 million inhabitants and also the main cluster of economic activities. The scheme followed the Grameen Bank model: a) clients are mainly women, often poor and vulnerable, who self-select each other to form solidarity groups, b) no collateral is required, c) loans are initially small but tend to increase after successful repayments, d) late repayment results in loss of future credit, and e) borrowers are required to contribute to a saving fund.
The first contact with local people was through GNO'NU's local staff. They

were assigned to Godomey, in the periphery of Cotonou, to attract people's attention through a series of information meetings about the program. These were held in the main public squares of each neighborhood. When the first meetings were called, the staff explained the program's philosophy, rules and objective and potentially interested women were invited to attend the follow up meetings. They did not discriminate the participants in terms of wealth, relying on the consolidated belief that microcredit is not attractive to the better off. Then, women where selected by a first screening process based solely on possession of a valid national identification card. Then, after the self-selection in groups of three, women were screened by the verification of no family ties between members of the same group.

The first 49 groups were served in 2001. The loan size was 20000 CFA, about $30 per member, that is roughly equivalent to the monthly wage of a well paid job in Cotonou at the time. The loan was payable over six months at the interest rate of 11.8%, of which 3% was earmarked for a saving fund. [3] During the loan cycle, October 2001-April 2002, borrowers were provided training courses to manage their businesses. At the end of the sixth month, the repayment rate was 100% and in some cases loans were repaid in advance. This was the first loan cycle, with the second now in progress.

When groups were already formed and working as a credit unit, GNO'NU's local staff asked to fill a questionnaire to have a better understating of beneficiaries' socio-economic characteristics and previous credit history. The survey consists of 147 women mainly vendors concentrated in the luxury sector (62%), where "luxury" is defined as the retail of nonessential items such as seasonings (17%), household services and specialty goods (e.g. confectionery and beauty care products) (45%). The rest of the women (38%) were in the basic sector, defined as the retail of necessity items, composed of staples (19%), fuel (9%) and vegetables (10%). We characterize vendors in the basic sector as deploying low risk projects relative to vendors of luxury items. This is because the demand for basic goods is income inelastic while the demand for nonessential items is relatively elastic. Hence, borrowers selling basic goods have safer returns in the face of cyclical income fluctuations relative to groups members selling luxury goods.

Figure 1 shows the distribution of financial resources other than group

[3]In 2001 the inflation rate was 3%, implying the real interest rate to be 5.8%.

lending, namely credit from other sources and personal contribution. In terms of sources of investment funds, credit from other sources was available to 12.2% and 94% declared to have invested some personal contribution to the investment project. The data set also contains information on group composition, education, place of residence and activity, marital status, husband activity, profits earned from previous project and number of children. Figure 2 shows that 46% of women lack any schooling attainment, 24% finished primary school and 26% finished secondary school. Also, 56% of women are diversified relative to their husband's activity. The latter is classified as either blue collar (i.e. unskilled workers) or white collar (i.e. professionals). Blue collar (e.g. fishermen, agricultural laborers) tend to be associated with more basic sectors relative to white collar (e.g. teachers, electricians). Hence, a household is diversified either if the woman is in the basic sector and her husband white collar or if the woman is in the luxury sector and her husband blue collar. Otherwise, the household is specialized.

4.2 Variable Description and Methodology

We constructed the variables of interest from GNO'NU's data file. The data file, firstly, specifies name, surname and group membership. Household composition information, including marital status, surname and profession of borrower's husband, number of children and place of residence is also available. Borrower's activity is reported by goods sold and workplace. Often women had two or more occupations at the same time, but we ordered their activity by first occupation. The financial variables are personal contribution to the investment, revenues earned from previous project, credit from other sources and the microcredit loan amount and terms. Descriptive statistics of the variables used in the empirical analysis are presented in Table 1. The dependent variable that we concentrate on is the personal contribution invested in the activity. The personal contribution devoted to the activity is deemed to perform the function of collateral. We use the TOBIT estimation procedure because data are available for the entire sample but the dependent variable exhibits censoring at the value of zero. In fact, we do not observe the personal contribution when is negative as we do not have information on debt. Personal contribution, PCON, is defined as a share of the total investment, defined as the sum of personal contribution, credit from other

sources and the micro-credit loan. In the same way, we construct COS, credit obtained from other sources and OLDREV, a measure of maximum profits earned by previous project due by revenues on the total investment. We cannot analyze repayment performance as there were no occurrences of group default precluding any variability that can be exploited empirically.

The second group of variables describe sectors of activity. We initially distinguish between two main sectors: basic and luxury. With BAS, basic, we divide women selling staples, fuel and vegetables by women, in the luxury sector, selling seasonings, services and specialities goods. Then, we specify the composition of groups with respect to goods sold with GSTA, GFUE, GVEG, GSEA, GSER as the fraction of group members selling staples, fuel, vegetables, seasonings, and specialty goods respectively.

The third group of variables are household characteristics. In developing countries, women's decisions are generally subordinated to men consensus. Hence, we may think the entrepreneurial initiatives to be subjected to the same regime, especially if both men and women operate in the same sector. Diversification of the family is captured by HDIV, household diversification, a dummy with value 1 if women selling basic goods are married to a husband with white collar activity (e.g. teachers and other professionals) or selling luxury items are married to husband with blue collar occupations (e.g. fishermen and construction workers). Otherwise, HDIV is zero. Group members who want to prioritize minimization of insolvency probability and insure themselves, might take into account the entire family risk profile, rather than the marginal effect on the risk profile of this single project (e.g. Zeller, 1998). Evaluation on a potential partner might be, therefore, influenced by consumption, production and portfolio decisions. Goetz and Sen Gupta (1995) studies reveal loan accorded to women, if not destined to traditional women activities, to be invested in men of the family, husbands and sons, activities. Control over loans seems to be higher when borrowers are either widow or single (Goetz and Sen Gupta, 1995). From this consideration, the idea of the variables S, single, CHIL, children, and ER, early repayment: dummies equal to 1 when the woman is single or widow and, if single or widow, when repays the loan early. Moreover, control over loans may be influenced by education, EDU, that may be a sort of positive spillover to the other women, especially illiterate (De Weerdt, 2001). We also want to study whether personal contribution may mitigate asymmetric information problems.

From the data set, we know that numerous women work and/or live in the

same neighborhood as other members of the group and we think forms of monitoring may intervene, in such a way to substitute personal contribution. Figure 3 illustrates IWOR and IRES, which are two dummies with value 1 if a particular borrower respectively either works or lives in the same place as another member of the group. We have that 77% of women share workplace with a peer borrower and 79% share residence with a peer borrower. GWOR and GRES indicate the proportion of women of a group working/living in the same place. Thus, they are 1 when all work/live in the same place, 0 if all work/live in different places, 1/3 and 2/3 if 1 or 2 work/live in the same place. Figure 4 shows high prevalence of daily interaction as groups with members working or living in the same place are common. Then, to investigate how the selection process takes place, we explore the group formation process with respect to risk: homogeneous versus heterogeneous group formation. GBAS is the fraction of group members in the basic sector and takes the values of 1, 1/3 and 2/3 when all, one or two members are in the basic sector. On the other hand, group diversification is expressed by GDIV, which takes the value of 1 when GBAS is either 1/3 or 2/3, and the value of 0 otherwise. Figure 5 shows that 80% of groups are diversified with a mix of safe and risky borrowers. Of the 20% specialized groups, 15% concentrate in basic goods.

Furthermore, to characterize the nature of group formation when the group is heterogenous, we highlight the odd one out operating in either the basic or the luxury sector with OOOB and OOOL. What we want to study is whether operating either in the safe basic sector or in the luxury risky sector involves considerations regarding insurance provision from the risky borrower to the safe borrowers in order for the risky to be accepted into the group. In particular, OOOB = 1 if BAS = 1 and GBAS = 1/3 and OOOL = 1 if BAS = 0 and GBAS = 2/3. Among odd one out borrowers (i.e. those who make the group heterogenous), 19% sell basic goods and 7% luxury goods. Finally, to draw the profile of the odd one out we consider the possibility she is married to a white collar professional. MOB and MOL are obtained by MARWHI $\cdot$ OOOB and MARWHI $\cdot$ OOOL respectively, where MARWHI is a variable describing borrowers married with a white collar professional. Then, we consider the case of an odd one out belonging to a diversified family: HC1 = (1- HDIV) $\cdot$ OOOB and to a specialized family: HC2= HDIV $\cdot$ OOOL. These variables tell us whether borrowers contributing insurance to the group originate from diversified households.

The scope and needs for household consumption smoothing affect the possibilities for borrowers to achieve risk sharing through group lending.

5 Results

In the first regression, we use a LOGIT specification to explore how borrower and household characteristics determine the choice of a risky project. The dependent variable is LUX= (1-BAS) and the independent variables we included are: HDIV, COS, OLDREV and the control variables: EDU, S and CHIL. The results in Table 2 show that more credit from other sources, household diversification and high sales from previous project are associated with the selection to enter the luxury sector. It seems that to the extent that a borrower is less liquidity constrained and more able to smooth household consumption, risky projects are more attractive. Since the less constrained borrowers choose riskier projects, we infer that the expected return in the luxury sector is higher, and also that there is may some scope for insurance within groups.

Throughout our regression analysis we have as dependant variable the fraction of total investment which is financed with personal contribution of the group member. We use this variable to measure the collateral represented by the assets that the group member has personally contributed to her investment project. We control for both household and project characteristics. In the first set of regressions, we include variables characterizing the risk structure of both the household and the group. The first interesting outcome is that credit from other sources is an imperfect substitute of personal contribution: the coefficient of COS is negative, highly significant and in most specifications it is close to 2/3. The fact that the estimated coefficient is negative suggests that personal contributions and credit from other sources are indeed substitutes. But the fact that the absolute value of the estimated coefficient is less than one suggests that credit from other sources is an imperfect substitute for personal contributions. Such a result is, to some extent, not surprising. First, credit from other sources may only be available on dear terms. Second, having loans with other creditors might induce borrowers, in moments of financial difficulties, not to reimburse the microcredit first. This result turns out to be robust throughout all of our specifications.

From Table 3, women in diversified households tend to put personal

contributions roughly 7% higher. This may be due to two separate effects. First, diversified household may be less able to provide insurance to other group members under the joint liability agreement because if their project is profitable but their husband's income suffers a negative shock, they are more likely to bailout the household before they bail out other group members. Hence, household diversification deters the borrower from engaging in mutual insurance. This effect may be mitigated by providing a higher personal contribution for collateral purposes. Second, another possible reason for higher personal contributions is that diversified households may be in a better position to engage in larger investments. Therefore, group members from such households are more likely to have to resort to personal contributions as microcredit and credit from other sources are limited.

Also, the fraction of women within the group working or living in the same place is associated with lower personal contributions by 21% and 19% respectively. Having an additional group member sharing location is correlated with a reduction of about 6% in the personal contribution. Working in the same place can be associated to the capacity of being able to monitor effort and living in the same place may be translated into a superior knowledge about group members types. Hence by mitigating moral hazard and adverse selection, when more group members work and live in the same place, there is a reduction in the need for collateral. Table 3 includes two other group characteristics. The higher share of group members with projects in the basic sector, the lower personal contributions. One more group member who is a vendor of necessity items is associated with a drop of 5% in the share of personal contributions. Because, essential items are always in demand, they are not subject to decline on the face of cyclical fluctuations. Hence, more women in group working in the basic goods sector, means more low risk group members. Now, we characterize group heterogeneity by denominating the group as diversified if it has both low risk members (project in basic sector) and high risk members (project in luxury sector). The latter are low risk because the income elasticity of the products they supply is much higher. In diversified groups, the share of investments financed with personal contributions is 13% higher according.

In Table 4, we introduce two additional variables which give information about the group member's position within the group. One is dummy variable which is 1 if the woman works in the same place as some other group member and the second tells us whether the woman lives in the same building as another woman in the group. These variables are not highly

significant when we do not include the group indicator about the fraction of women sharing workplace or living quarters. When we include the latter, we find that conditional upon sharing location, being one of the women in the group in such situation is associated with a higher contribution. This higher collateral may compensate for risk from operating in the same local market, which limits the scope for risk diversification within the group. The effects a large share of low risk members and of group heterogeneity remain robust both in significance and magnitude. Having more basic good projects in the group leads to less need for collateral while heterogenous risk groups are associated with higher personal contributions.

Whether the project is in the basic or luxury sector is also not informative until we incorporate variables controlling for the individual's impact on group heterogeneity. The dummy variable indicating that the investment is in a project to supply basic goods is insignificant in the first and second group of regressions, that is when we do not specify the type of odd one out in the group. These results suggest the presence of other elements determining group formation. However, in Table 2 we show that when we run the LOGIT regressions we know the choice to operate into the luxury sector to be influenced by belonging to a diversified households and having more credit from other sources compared to a women entering in the basic sector. As far as individual and household characteristics are concerned, what matters is household diversification. A higher personal contribution, when women belongs to diversified families, may be interpreted as a minor capacity of selling insurance to high risk members. In fact, if the husband's activity goes bad, it is plausible suppose the woman will divert the credit to the family. Thus, in order to be accepted by the group the personal contribution has to be 6 to 8 % higher. More precisely, women in the volatile sector from diversified households need to provide less collateral. Blue collar husband lowers probability of group loan default, whereas women in low risk sector in diversified households need to provide more collateral. White collar husband hampers insurance to the group. Regarding project characteristics, having obtained high returns may be a signal of goodness of the activity and hence requires less personal contribution. Moreover, being the odd one out of the luxury sector implies more collateral in order to be accepted in the group. In other words, high risk members buy insurance from low risk members. On the other hand, being the odd one out in the basic sector lowers the probability of group default. Then, low risk group members when the other members are both high risk, face a lower personal

contribution requirement. Agents without collateral but willing to play this insurance role in the group may be able to access credit.

In Table 5, we incorporate two sets of new variables. One tells us whether the woman who makes the group heterogenous, which we label odd one out (OOO henceforth) is in the basic or luxury sector. If she is in the basic sector, her role is basically that of providing insurance to the group. In this case, the associated drop in the personal contribution is between 25 and 28%. If she is in the luxury sector, other things equal, she may raise the risk profile of the group and is receiving insurance. Our findings indicate a tendency for the contribution of OOO risky borrowers to be higher. Furthermore, we find that OOO group members in the luxury sector only have to put more collateral when they are in diversified households. When they are in specialized households, odd one out members in luxury sector actually contribute do not have to contribute additional collateral. This is because originating in a undiversified household actually mitigates incentives for strategic default when the risky project performs well. Then, there is no need to divert resources from the group to the family to compensate for negative shocks in their husband's income. This solves the main problem posed by risky borrowers which is not that they require insurance when projects fail but rather that bailouts may be caused by strategic behavior. In contrast, when OOO borrowers are low risk, their need to provide collateral is lessened by household diversification. In this case, what matters is the ability of the borrower to provide insurance in bad states of the world, which is facilitated by household diversification rather than specialization.

Finally, Table 6 introduces an independent variable measuring sales to investment ratio from the last project of the group member. This variable captures both the borrowers track record as an investor and availability of funds for collateral. The results indicate that the former effect is more important as higher revenue in the past is associated with less need for collateral in the present. When we control with this past performance measure, some of the group variables become insignificant. In particular, common work place and residential location are not associated with personal contributions in any systematic way. However, the risk profile of the group has an impact which is consistent . As before, more safe borrowers induce lower collateral and group heterogeneity leads to higher collateral requirements for risky borrowers.

The lack of need for collateral complete for borrowers from specialized households. In the presence of this variable the most important effect, in

terms of the group's risk structure affecting collateral, is that the OOO from the luxury sector group member from a specialized household contributes 30% less of her own resources to the overall investment, completely offsetting the need for higher personal contribution arising from her inducement of group heterogeneity. Hence, as long as they are not impeded household consumption smoothing demands, even risky borrowers making the group heterogenous do not hamper intra-group insurance through strategic default. Addressing the issue of homogeneous groups versus heterogeneous groups, belonging to a low risk group, in the sense that a higher fraction of group members has projects in basic good provision, means less probability for joint liability to generate group default. This outcome is costly to all group members in the sense that access to microcredit is lost. In order to avoid group default, some group members may decide to bailout others. Having to make such a contribution increases financing costs. Hence, other things equal, individuals avoid situations in which they expect the prospect that they have to bailout the group. In particular, the probability of bailout is minimized the more homogenous the group is because conditional upon success an individual's project, the probability that the other members of the group failed is at its lowest. However, from the point of view of the lender, this implies that groups are specialized and there is no risk pooling in group formation. This may raise the likelihood of collusion. In a group that diversifies risk, collateral mitigates bailout prospects. The more diversified is the group, the higher personal contributions to investment are to offset bailout prospects. Collateral is indeed a catalyst for risk sharing beneficial both to the jointly liable group and to the lender. The evidence is very robust that collateral is a vehicle to mitigate moral hazard, due to strategic default, which in turn facilitates risk sharing. While borrowers with risky projects but with good track records can avoid higher collateral due to working or living elsewhere relative to peers, they cannot avoid higher collateral due to the higher probability of bailouts by safe borrowers associated with risk pooling.

6 Conclusion

In the model, we show that collateral is a mechanism for avoiding default under joint liability. To the extent that group default is not only harmful to the lender but also to group members losing access to future credit, personal

investment contributions can enhance group formation under joint liability. In the present context, without social sanctions, unless collateral is sufficiently high, we cannot be certain that group lending will deliver higher repayment rates than individual lending. Hence, the negative spillovers from unprofitable projects are mitigated as group members with profitable projects and lenders can avoid the losses due to group default. At the same time, collateral can enhance the prospects of group members without collateral to access credit under joint liability as the willingness of other borrowers to form a group with them rises when they provide insurance by self-selecting into the safe basic sector.

Our empirical results show that heterogenous groups emerge in which members with high risk investment projects mitigate default prospects through collateral. This shows that joint liability is conducive to insurance provision as long as there is a mechanism for high risk investors in the group to compensate low risk investor members. In the past, it has been suggested that transfers or side payments could sustain heterogenous groups in what effectively amounts to high risk members purchasing insurance from low risk ones. However, there is no evidence provided that such transfers take place. Yet, the evidence of intra-group insurance would seem consistent with the notion that patient borrowers will avoid strategic default as loss of future credit is very costly.

We establish that personal contributions to investment projects play the same role as collateral in that low risk group members are willing to join liability agreements with high risk group members who provide substantial personal contributions. While generally group members in the basic sector are able to join without providing collateral, as they provide insurance. Members in the luxury sector also seem to be able to provide insurance as long as they come from specialized households. This is because when they come from diversified households, and they do well, they first have to help at home before they can commit profits to bail out other group members out.

In general, collateral in the form of personal contribution to the investment project, mitigates risk in group formation. In our empirical analysis, we find that when borrowers live or work together, when they come from undiversified households, when they are low risk and in homogenous groups, ans when they have good track records, then the need for collateral is lessened. There is a synergy between low and high risk group members in that, in the absence of social capital, borrowers without collateral would not

have access to credit. At the same time, those borrowers by specializing in low risk activities provide insurance to borrowers with collateral who would obtain credit in any case but otherwise would lack access to insurance against default. This finding about the benefits of group lending when agents with different collateral possibilities interact is consistent with the finding by Ahlin and Townsend (2002). They report evidence from microcredit programs in Thailand that in more prosperous regions, intra-village wealth heterogeneity is associated with more intensive use of group lending and that there is a U-shaped relationship between group borrowing and household wealth. The common concern that when the poorest are not the recipient of microcredit there is a welfare loss may not be operational in this contexts. Crowding in of poor borrowers rather than crowding out may operate in urban environments, and other settings in which heterogeneous households interact, in which the level of social capital common in rural village communities is unlikely to materialize and provide sufficient information access and strong enough sanctions to sustain group lending without collateral.

In developing countries, where a large share of households live perilously close to subsistence thresholds, household earnings risk can have a particularly substantial impact on welfare. Mechanisms for risk sharing across households are of paramount importance. Attanasio and Davis (1996) have shown that even in the US, where contingent security markets are far more advanced than in any developing country, the joint distribution of household earnings and consumption observed in cross sectional data is inconsistent with the complete insurance against earnings risk availablein the Arrow-Debreu setting. Hence, when insurance markets are missing and household consumption smoothing via self-insurance is scarcely feasible, the introduction mechanisms to further risk sharing is crucial. Group lending schemes, mostly used in rural communities, when deployed in urban areas - or other situations in which agents with and without collateral interact - could facilitate risk sharing between households.

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Appendix

The specification of the game and subsequent proofs follow Besley and Coate (1995) but rather than using social sanctions to punish strategic default by borrowers, group members resort to asset repossession as specified in the set up of the model above. The repayment game has two stages. At the first stage, borrowers decide whether to contribute (c) or not to contribute (n) their share of the outstanding loan payment due, r. At the second stage, conditional on the decisions taken by both borrowers at the first stage, each chooses either to pay, (P), or default (D). The Game leads to seven Cases of Subgame Perfect Equilibria.

Case1: If $\theta_i \geq \phi(2r), \quad i = 1,2,$ then there are three sub-cases:

(a) If $R(r,\theta_i) > r$ for $i = 1,2,$ then $\{(c,P)(c,P)\}$ is an equilibrium

(b) If $R(r,\theta_1) > r$, then $\{n,(c,P)\}$ is an equilibrium

(c) If $R(r,\theta_2) > r$, then $\{(c,P),n\}$ is an equilibrium

Case 2: If $\theta_1 > \phi(2r)$ and $\theta_2 < \phi(2r)$, then there are two sub-cases:

(a) If $R(r,\theta_2) < r$, then $\{(c,P),n\}$ is an equilibrium

(b) If $R(r,\theta_2) > r$, then $\{(c,D),(c,P)\}$ is an equilibrium

Case 3: If $\theta_2 > \phi(2r)$ and $\theta_1 < \phi(2r)$. This is symmetric to Case 2.

Case 4: If $\theta_i \in (\phi(r),\phi(2r))$, i=1,2, then $\{(c,D),(c,D)\}$ and $\{n,n\}$ are both equilibria

Case 5: If $\theta_i < \phi(r)$, i=1,2, then $\{n,n\}$ is the only equilibrium

Case 6: If $\theta_1 \in (\phi(r),\phi(2r))$ and $\theta_2 < \phi(r)$, then there are two subcases:

(a) If $p(\theta_2) + R(p(\theta_1) - r,\theta_2) > r$, then $\{(c,D),(c,D)\}$ is an equilibrium

(b) If $p(\theta_2) + R(p(\theta_1) - r,\theta_2) < r$, then $\{n,n\}$ is an equilibrium

Case 7: If $\theta_1 < \phi(r)$ and $\theta_2 \in (\phi(r),\phi(2r))$. This is symmetric to Case 6.

Proof of Proposition 1: If at least one borrower has a return bigger than $\phi(2r)$, we are in either Case 1, 2 or 3. In either Case the loan is repaid. If both

borrowers have returns between $\phi(r)$ and $\phi(2r)$, we are in Case 4 and since $\{(c,D),(c,D)\}$ is an equilibrium the bank's loan may be repaid. In the remaining Cases (5, 6 and 7), the bank's loan will not be repaid if $R(\bullet) = 0$.

Proof of Proposition 2: The only difference from this and Proposition 1, is the case when one borrower receives a return θ' between $\phi(r)$ and $\phi(2r)$ and the other borrower receives a return ϕ smaller than $\phi(r)$ but such that $p(\theta) + R(p(\theta') - r, \theta) > r$. This corresponds to Cases 6(a) and 7(a). In both cases $\{(c,D),(c,D)\}$ is an equilibrium and hence the bank loan may be repaid.

Proof of Proposition 3: For all $\mu > 0$, define the function $\theta_\mu : (\phi(r), \phi(2r)) \to (\underline{\theta}, \phi(r))$ implicitly from the equation $p(\theta_\mu(\theta') + \mu\lambda p(\theta') - r, \theta_\mu(\theta')) = r$. For social sanctions of strength μ, it should be clear that if one borrower has a return $\theta' \in (\phi(r), \phi(2r))$ and the other has a return $\theta < \phi(r)$, then repayment will occur if and only if $\theta > \theta_\mu(\theta').$ The probability of the latter event is $F(\phi(r)) - F(\theta_\mu(\theta'))$. It follows that we my write the repayment rate under group lending as

$$\Pi_G(r,\mu) \equiv 1 - F(\phi(r))([2F(\phi(2r)) - F(\phi(r))] + 2\int_{\phi(r)}^{\phi(2r)} \left[F(\phi(r)) - F(\theta_\mu(\theta'))\right] dF(\theta')$$

The last term represents the probability that one borrower has a return between $\phi(r)$ and $\phi(2r)$, and the other has a return lower than $\phi(r)$, but sufficient high for repayment to occur, while the rest corresponds exactly to the RHS of (2) above.

Substracting (1) from (5) yields,

$$\Pi_G(r,\mu) - \Pi_I(r) \equiv F(\phi(r))[1 - F(\phi(r))] - 2\int_{\phi(r)}^{\phi(2r)} \left[F(\theta_\mu(\theta'))\right] dF(\theta')$$

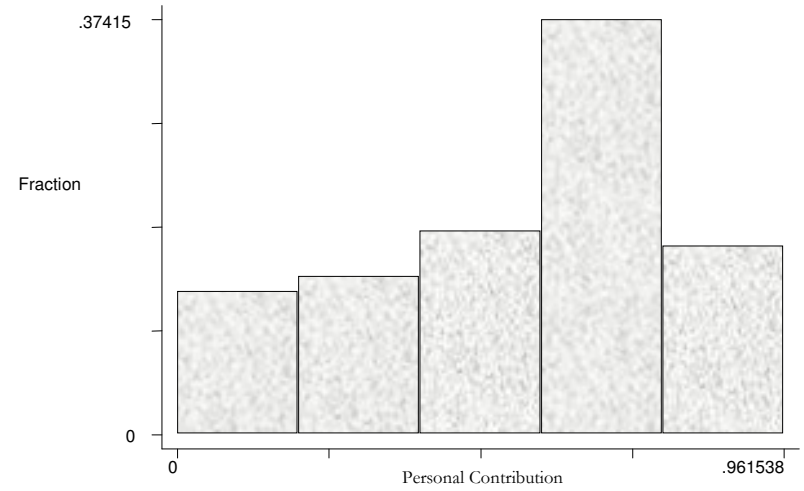
The first term in this expression, that favors group lending, is positive. The

second, that favors individual lending, is negative. But, as μ gets large this second term goes to zero. To see this, note first that for all $\theta' \in (\phi(r), \phi(2r)), \lim_{\mu\to\infty} \theta_\mu(\theta') = \underline{\theta}$; that is, as social sanctions get increasingly severe the critical project return necessary to induce repayment gets nearer and nearer to the minimal return. This follows from part (iii) of Assumption 1. Since F is continuous, it follows that for $\theta' \in (\phi(r), \phi(2r)), \lim_{\mu\to\infty} F(\theta_\mu(\theta')) = F(\underline{\theta})$. Moreover, since F is a distribution function, the sequence of functions $\langle F(\theta_\mu(\theta'))\rangle_{\mu=1}^{\infty}$ is bounded. Thus we may conclude from the Bounded Convergence Theorem that

$$\lim_{\mu\to\infty} \int_{\phi(r)}^{\phi(2r)} F(\theta_\mu(\theta'))dF(\theta') = \int_{\phi(r)}^{\phi(2r)} \lim_{\mu\to\infty} F(\theta_\mu(\theta'))dF(\theta') = \int_{\phi(r)}^{\phi(2r)} F(\underline{\theta})dF(\theta') = 0$$

.

Figure 1. Financing Structure



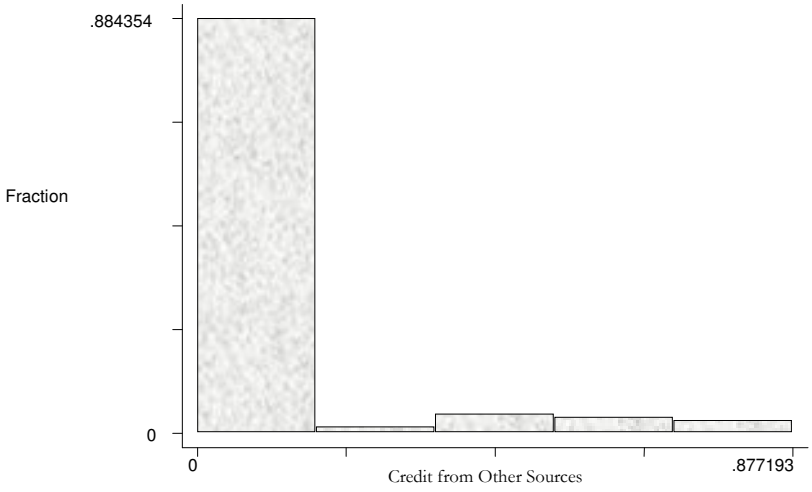
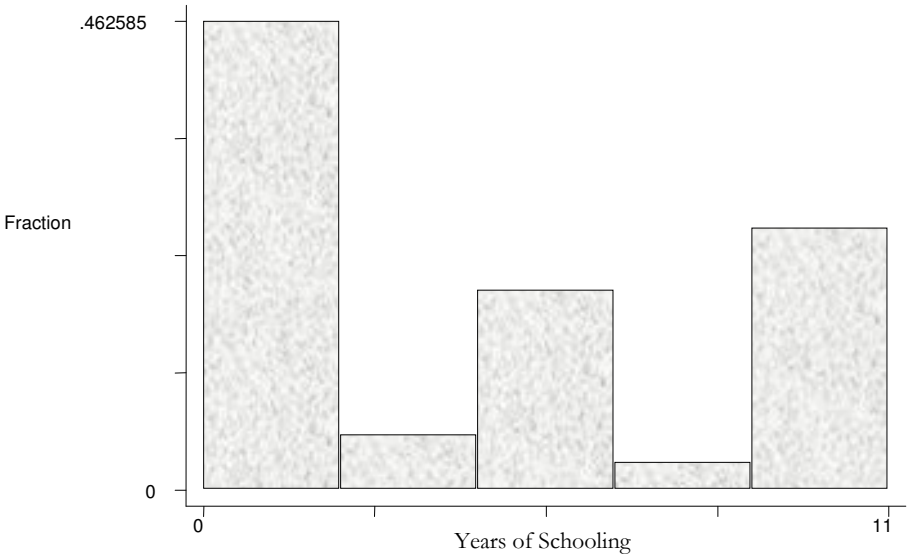


Figure 2- Borrower Characteristics



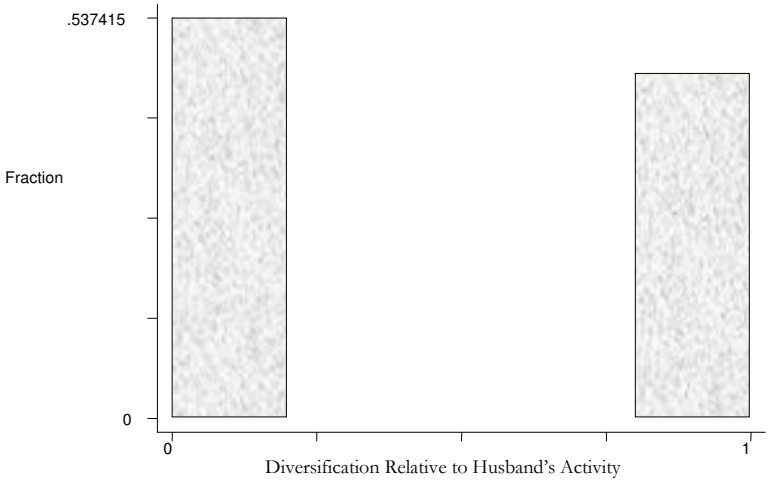
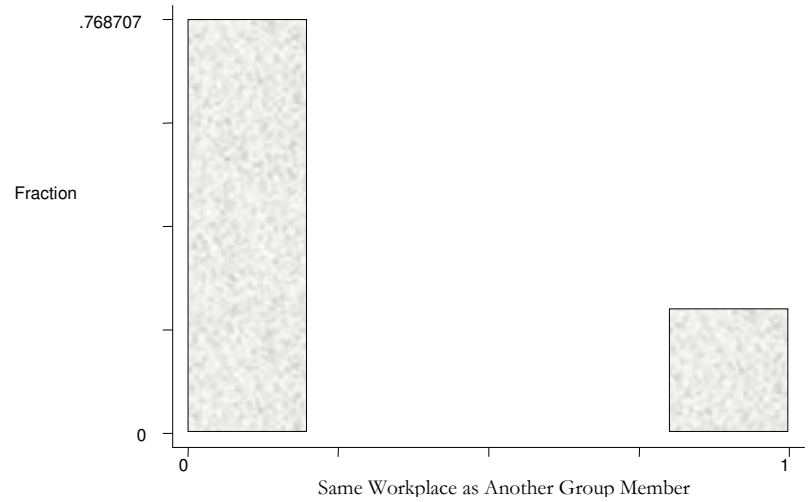


Figure 3 – Borrower's Relationship to Other Group Members



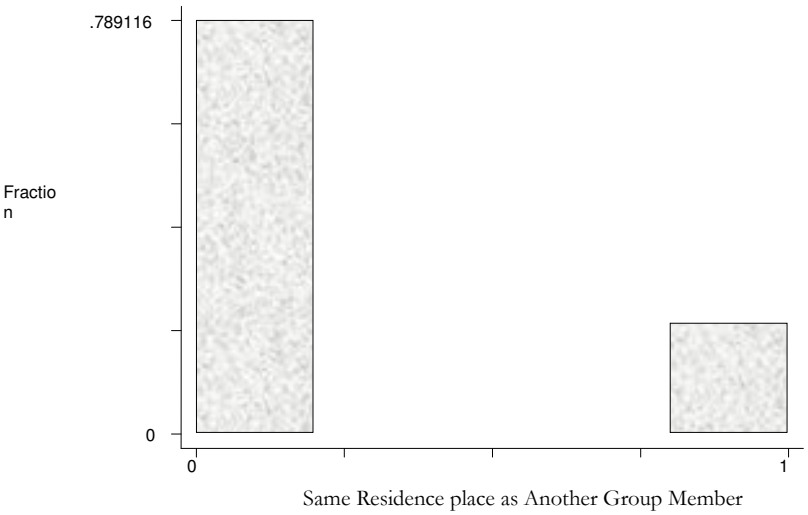


Figure 4 – Group Members' Daily Interaction

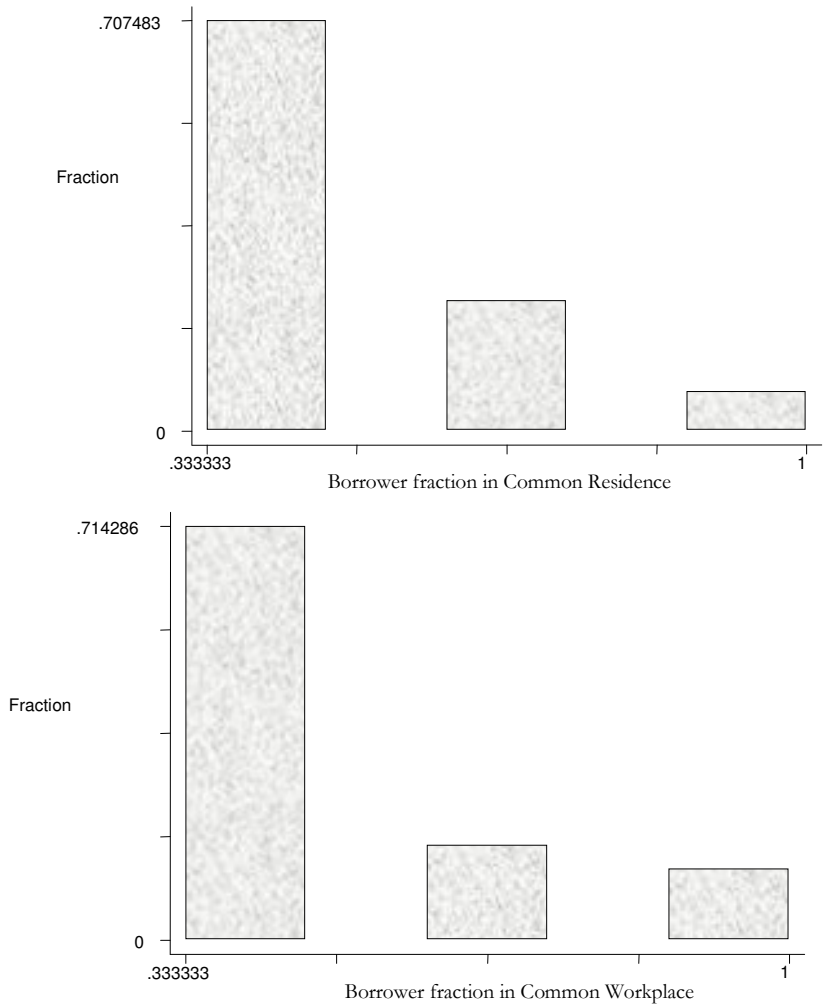
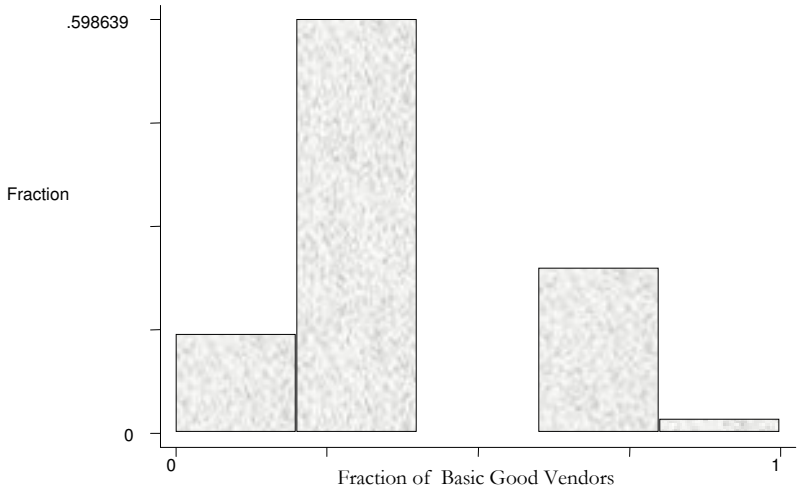


Figure 5 – Group's Risk Heterogeneity



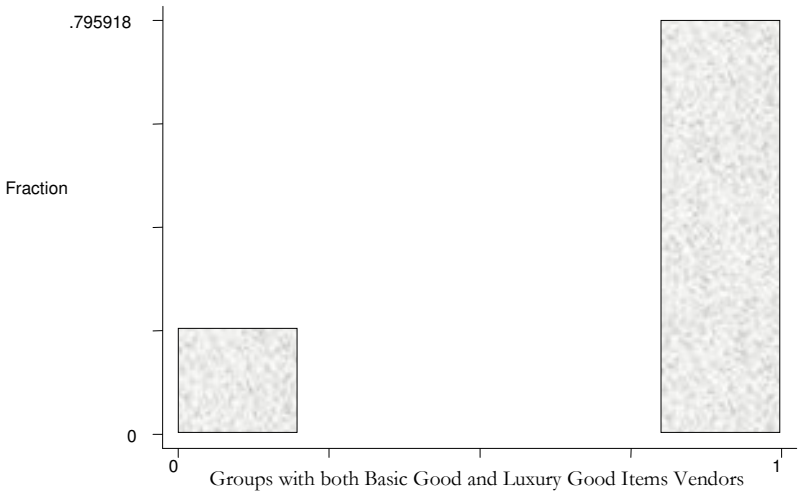
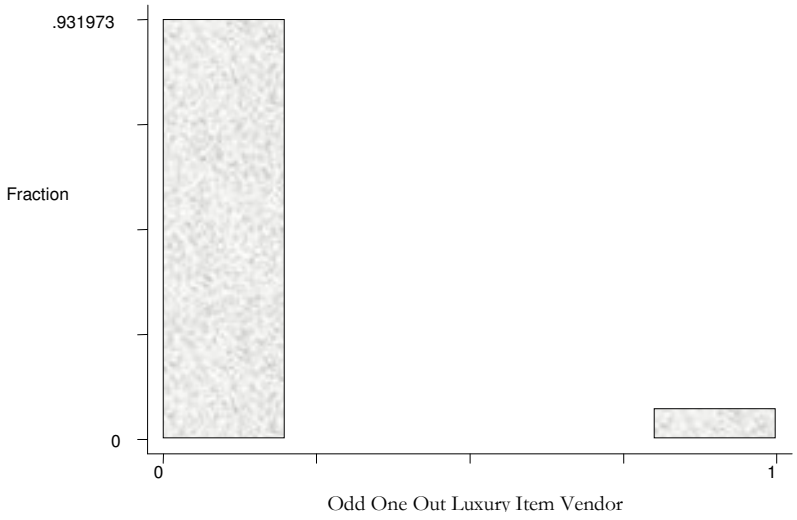


Figure 6 – Activity of Borrower inducing Group Heterogeneity



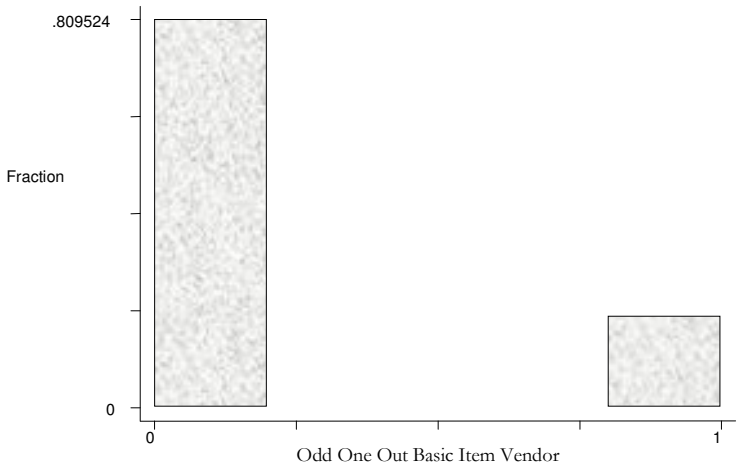


Table 1 – Descriptive statitistics

Variables	Definition	Average	Std. dev.	Obs
PCON	Personal contribution to the activity	0.534	0.253	147
COS	Credit from other sources	0.065	0.188	147
BAS	=1 if in the Basic sector	0.380	0.487	147
GSTA	Members of the group selling staples	0.217	0.219	147
GFUE	Members of the group selling fuel	0.088	0.147	147
GVEG	Members of the group selling vegetables	0.065	0.133	147
GSEA	Fraction of the group selling seasonings	0.176	0.225	147
GSER	Fraction of the group providing services or selling specialities	0.442	0.207	147
OLDREV	Revenue earned from previous activity	0.039	0.056	131
HDIV	Household diversification	0.462	0.5	147
MARWHI	=1 if Married with a "white collar"	0.251	0.435	147
S	=1 if Single	0.149	0.357	147
ER	=1 if Early repayment	0.054	0.227	147
EDU	Education	3.857	3.839	147
CHIL	Number of children	3.149	2.124	147
GWOR	Fraction of the group working in the same place	0.469	0.233	49
GRES	Fraction of the group living in the same place	0.453	0.202	49
IWOR	=1 A borrower works in the same place as someone else in the group	0.231	0.423	147
IRES	= A borrower lives in the same place as someone else in the group	0.210	0.409	147
GBAS	Fraction of the group in the Basic sector	0.378	0.222	49
GDIV	Group diversification	0.795	0.404	49
OOO	=1 if Odd one out	0.265	0.443	147
OOOB	=1 if Odd one out in the Basic sector	0.190	0.394	147
OOOL	=1 if Odd one out in the Luxury sector	0.068	0.252	147
MOB	=1 when Odd one out in the Basic sector and married with a "white collar"	0.047	0.213	147
MOL	=1 when Odd one out in the Luxury sector and married with a "white collar"	0.013	0.116	147
HC1	=1 when Odd one out belonging to a diversified household	0.170	0.376	147
HC2	=1 when Odd one out belonging to a specialized household	0.142	0.351	147

Table 2 – Project Risk

Independent variables	Dependent variable	
	Luxury item vending project Dummy	
COS	1.311*	1.653*
	(1.095)	(1.118)
HDIV	1.103***	1.088*
	(0.388)	(0.396)
OLDREV	1.314**	1.138***
	(3.392)	(3.518)
Control household characteristics	NO	YES
Number of Obs.	131	131
Pseudo R^2	0.0558	0.0674

Table 3 – Collateral and Group Characteristics

Independent variables	Dependent variable					
	PCON					
COS	-0.638***	-0.621***	-0.623***	-0.594***	-0.582***	-0.585***
	(0.099)	(0.099)	(0.100)	(0.097)	(0.097)	(0.098)
HDIV	0.084**	0.086***	0.085***	0.069**	0.071**	0.068**
	(0.037)	(0.037)	(0.038)	(0.036)	(0.036)	(0.037)
IWOR						
IRES						
GWOR				-0.208***	-0.199***	-0.201***
				(0.081)	(0.081)	(0.081)
GRES				-0.190***	-0.188***	-0.189***
				(0.093)	(0.093)	(0.093)
GBAS	-0.160**	-0.159*	-0.154*	-0.211***	-0.208**	-0.196***
	(0.087)	(0.087)	(0.095)	(0.087)	(0.086)	(0.094)
GDIV	0.130***	0.138***	0.138***	0.125***	0.131***	0.131***
	(0.048)	(0.048)	(0.048)	(0.047)	(0.048)	(0.048)
Control household characteristics	NO	YES	YES	NO	YES	YES
Control project characteristics	NO	NO	YES	NO	NO	YES
Number of Obs	147	147	147	147	147	147
Pseudo R^2	0.8662	0.8973	0.8977	1.0416	1.0620	1.0639

Table 4 – Collateral and Borrowers Relation to the Group

Independent variables	Dependent variable					
	PCON					
COS	-0.621***	-0.607***	-0.609***	-0.582***	-0.568***	-0.572***
	(0.099)	(0.099)	(0.099)	(0.097)	(0.097)	(0.097)
HDIV	0.073**	0.078***	0.074**	0.072**	0.074***	0.071**
	(0.037)	(0.037)	(0.038)	(0.037)	(0.037)	(0.038)
IWOR	-0.074*	-0.069*	-0.069*	0.052	0.049	0.049*
	(0.045)	(0.045)	(0.045)	(0.094)	(0.094)	(0.094)
IRES	-0.013	-0.010	-0.010	0.117*	0.124*	0.124*
	(0.046)	(0.046)	(0.046)	(0.074)	(0.074)	(0.074)
GWOR				-0.288*	-0.271*	-0.273*
				(0.171)	(0.171)	(0.171)
GRES				-0.380***	-0.389***	-0.391***
				(0.150)	(0.150)	(0.150)
GBAS	-0.186***	-0.184***	-0.176**	-0.214***	-0.211***	-0.197***
	(0.088)	(0.087)	(0.096)	(0.086)	(0.086)	(0.094)
GDIV	0.135***	0.142***	0.142***	0.130***	0.136***	0.136***
	(0.048)	(0.048)	(0.048)	(0.047)	(0.047)	(0.047)
Control household characteristics	NO	YES	YES	NO	YES	YES
Control project characteristics	NO	NO	YES	NO	NO	YES
Number of Obs	147	147	147	147	147	147
Pseudo R^2	0.9170	0.9419	0.9426	1.1033	1.1291	1.1315

Table 5 – Collateral and Group Risk Heterogeneity

Independent variables	Dependent variable					
	PCON					
COS	-0.609***	-0.614***	-0.657***	-0.625***	-0.623***	-0.621***
	(0.096)	(0.099)	(0.096)	(0.096)	(0.097)	(0.096)
HDIV	0.072**	0.064*	0.073**	0.073**	0.082**	0.086***
	(0.040)	(0.040)	(0.041)	(0.040)	(0.042)	(0.041)
IWOR	0.015	-0.009	-0.027			
	(0.094)	(0.094)	(0.090)			
IRES	0.115*	0.107*	0.127**			
	(0.073)	(0.073)	(0.070)			
GWOR	-0.216	-0.162	-0.111	-0.194***	-0.182***	-0.152**
	(0.171)	(0.171)	(0.167)	(0.079)	(0.079)	(0.080)
GRES	-0.379***	-0.363***	-0.294***	-0.195***	-0.190***	-0.154*
	(0.148)	(0.147)	(0.145)	(0.092)	(0.091)	(0.093)
GBAS	-0.227***	-0.244***	-0.646***	-0.226***	-0.229***	-0.449***
	(0.092)	(0.091)	(0.250)	(0.093)	(0.092)	(0.154)
GDIV	0.135***	0.146***	0.198***	0.129***	0.138***	0.178***
	(0.048)	(0.048)	(0.056)	(0.048)	(0.049)	(0.053)
OOOB	-0.018	-0.026	0.283**	-0.009	-0.097	-0.256**
	(0.055)	(0.055)	(0.155)	(0.055)	(0.121)	(0.149)
OOOL	0.040	0.059	0.120	0.054	0.051	0.152*
	(0.086)	(0.086)	(0.109)	(0.086)	(0.087)	(0.104)
MOL	-0.175	-0.177	-0.253*	-0.193	-0.276*	-0.290*
	(0.173)	(0.171)	(0.194)	(0.174)	(0.197)	(0.195)
MOB	-0.185	-0.151	0.021	-0.200**	-0.120	-0.084
	(0.102)	(0.102)	(0.145)	(0.101)	(0.134)	(0.134)
Control household characteristics	NO	YES	YES	NO	YES	YES
Control project characteristics	NO	NO	YES	NO	NO	YES
Number of Obs	147	147	147	147	147	147
Pseudo R^2	1.2287	1.4479	1.5468	1.1781	1.2084	1.2670

Table 6 – Collateral, Heterogeneity and Member's Group Position

Independent variables	Dependent variable					
	PCON					
COS	-0.653***	-0.641***	-0.642***	-0.609***	-0.598***	-0.604***
	(0.097)	(0.098)	(0.096)	(0.096)	(0.096)	(0.095)
HDIV	0.076**	0.076**	0.091***	0.072**	0.072**	0.087***
	(0.041)	(0.041)	(0.042)	(0.040)	(0.040)	(0.041)
IWOR	-0.075*	-0.070*	-0.054	0.015	0.014	0.002
	(0.044)	(0.044)	(0.044)	(0.094)	(0.093)	(0.092)
IRES	-0.020	0.017	0.003	0.115*	0.121*	0.133**
	(0.045)	(0.045)	(0.045)	(0.073)	(0.073)	(0.072)
GWOR				-0.216	-0.203	-0.150
				(0.171)	(0.170)	(0.170)
GRES				-0.379***	-0.386***	-0.365***
				(0.148)	(0.148)	(0.147)
GBAS	-0.212***	-0.215***	-0.499***	-0.227***	-0.228***	-0.457***
	(0.094)	(0.093)	(0.155)	(0.092)	(0.092)	(0.153)
GDIV	0.141***	0.148***	0.202***	0.135***	0.142***	0.187***
	(0.049)	(0.050)	(0.054)	(0.048)	(0.048)	(0.053)
OOOB	-0.008	-0.119**	-0.309***	-0.018	-0.217	-0.291**
	(0.057)	(0.057)	(0.151)	(0.055)	(0.055)	(0.149)
OOOL	0.067*	0.078	0.189**	0.040	0.051*	0.138
	(0.087)	(0.088)	(0.103)	(0.086)	(0.086)	(0.103)
MOL	-0.179	-0.187	-0.284*	-0.175	-0.184	-0.288*
	(0.177)	(0.177)	(0.197)	(0.173)	(0.172)	(0.193)
MOB	-0.216***	-0.205***	-0.077	-0.185**	-0.175**	0.053
	(0.103)	(0.103)	(0.136)	(0.102)	(0.102)	(0.134)
Control for household characteristics	NO	YES	YES	NO	YES	YES
Control for project characteristics	NO	NO	YES	NO	NO	YES
Number of Obs	147					
Pseudo R^2	1.0658	1.0877	1.1968	1.2287	1.2523	1.3334

Table 7 – Collateral, Heterogeneity and Borrower Track Record

Independent variables	Dependent variable					
	PCON					
COS	-0.739***	-0.730***	-0.730***	-0.715***	-0.705***	-0.730***
	(0.079)	(0.080)	(0.079)	(0.080)	(0.081)	(0.080)
HDIV	0.032	0.032	0.047	0.028	0.029	0.050*
	(0.034)	(0.034)	(0.035)	(0.032)	(0.032)	(0.036)
IWOR	-0.100	-0.103	-0.110*	-0.074	-0.079	-0.094*
	(0.082)	(0.082)	(0.081)	(0.083)	(0.083)	(0.083)
IRES	0.024	0.027	0.039	0.038	0.042	0.050
	(0.061)	(0.061)	(0.061)	(0.062)	(0.062)	(0.062)
GWOR	0.034	0.044	0.077	-0.010	0.002	0.050
	(0.149)	(0.150)	(0.149)	(0.151)	(0.152)	(0.152)
GRES	-0.130	-0.135	-0.126	-0.126	-0.141	-0.128
	(0.127)	(0.127)	(0.126)	(0.126)	(0.130)	(0.129)
GBAS	-0.197***	-0.192***	-0.365***	-0.210***	-0.204***	-0.383***
	(0.082)	(0.082)	(0.130)	(0.084)	(0.084)	(0.131)
GDIV	0.094***	0.098***	0.132***	0.112***	0.117***	0.150***
	(0.043)	(0.044)	(0.047)	(0.044)	(0.044)	(0.047)
OOOB	-0.047	-0.046	-0.156	-0.005	0.005	-0.156*
	(0.047)	(0.047)	(0.124)	(0.041)	(0.041)	(0.091)
OOOL	0.039	0.043	0.108	-0.007	-0.004	0.057
	(0.069)	(0.070)	(0.084)	(0.064)	(0.064)	(0.083)
MOL	-0.251**	-0.254**	-0.329***			
	(0.139)	(0.139)	(0.155)			
MOB	-0.155**	-0.149	-0.056			
	(0.087)	(0.088)	(0.112)			
OLDREV	-1.935***	-1.896***	-1.855***	-1.907***	-1.860***	-1.823***
	(0.338)	(0.342)	(0.334)	(0.341)	(0.345)	(0.338)
Control household characteristics	NO	YES	YES	NO	YES	YES
Control project characteristics	NO	NO	YES	NO	NO	YES
Number of Obs	147	147	147	147	147	
Pseudo R^2	4.0518	4.0661	4.2016	3.7988	3.8181	